# MOLDS IN THE INDOOR ENVIRONMENT: Implications for Children's Health

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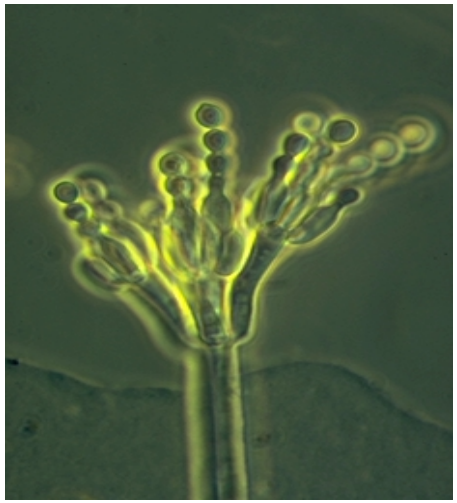


# HEALTHY INDOOR ENVIRONMENT

- One where adequate ***ventilation*** and ***comfort factors***, in conjunction with ***moisture control*** and effective and frequent ***cleaning***, controls indoor pollutants, with subsequent reduction of occupant exposures and corresponding decreases in human health risk.

# MOLD CONTAMINATION

Associated with water damage and moisture accumulation, indoor mold is currently the **most important IEQ issue in industrialized nations**.

# MOLD CONTAMINATION

- It's the major focus of **extensive litigation** in the IEQ field; and many states have put limits on claims.
- **Health effects** are associated with **chronic mold exposures**, and research continues.

# INDOOR MOLD

- San Francisco recently declared mold a **nuisance** under the city's nuisance ordinance.
- Recent California mold legislation required a scientific and public health assessment of the indoor mold problem.

# INDOOR ECOSYSTEMS

Indoor environments are ecosystems of **micro-environments** where organisms compete for moisture and nutrients (**substrates**) in relation to environmental factors.

# MICROENVIRONMENTS

- Carpet/upholstery
- Bathrooms
- Pet areas
- Crawlspaces
- Food storage areas
- Heating/AC systems
- Window frames
- Wall cavities/attic spaces

# MICROENVIRONMENTS

- Carpet
- Restrooms
- Cafeterias
- Trash cans
- Ceiling spaces
- HVAC systems
  - Ductwork
  - Drain pans
  - Air intakes

# MOLD SUBSTRATES

- Wood
- Wallboard
- Wallpaper
- Ceiling Tile
- Insulation
- Concrete
- Fireproofing
- Glues/sealants

# RESERVOIRS

- Microenvironments that collect and retain dusts and associated pollutants on a continual basis.
- Dry, maintained carpet typically contains at least **100,000 mold spores/gram of carpet dust**.

# SOURCES

- Sources are **reservoirs with uncontrolled moisture** (water damage) that initiates the mold cycle.
- This results in a **shift in ecology**, with growth, amplification and dissemination of spores and growth fragments.

# MOLD AMPLIFICATION

- Is rapid fungal growth under optimum $a_w$ conditions.
- Results from increased water activity (>24 hrs)
- Follows water migration.

# WATER ACTIVITY

- Xerophilic fungi have $a_w < 0.80$. These are "Primary colonizers" such as ***Penicillium*** species, ***Aspergillus versicolor***, and ***Wallemia***.
- "Secondary colonizers" ($a_w = 0.80 – 0.90$) include ***Cladosporium***, ***Paecilomyces***, and ***Aspergillus*** species.
- "Tertiary colonizers" ($a_w = >0.90$) include ***Stachybotrys***, ***Acremonium***, ***Fusarium***, ***Trichoderma***, ***Chaetomium***, and yeasts.

# WATER DAMAGE

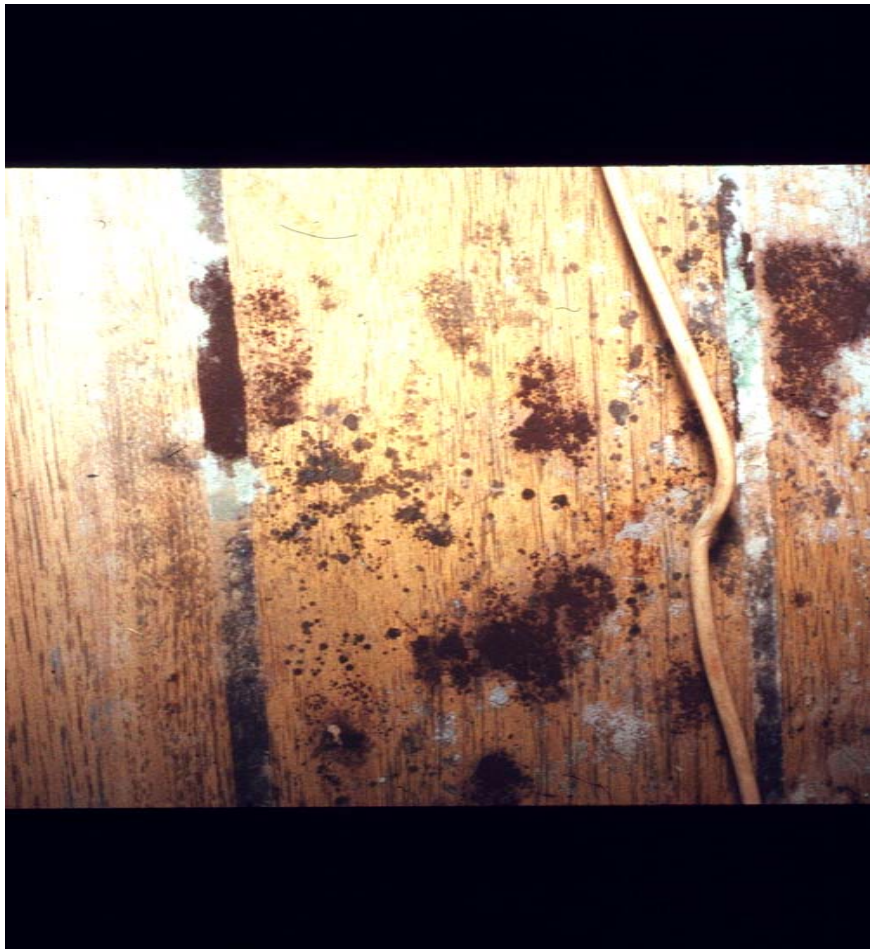
- **Catastrophic**
  - storm flooding
  - sewage backflow
  - Plumbing breaks
- **Insidious**
  - water intrusion, moisture buildup
- **Neglect**

# WATER DAMAGE

# WATER DAMAGE

# FUNGAL ECOLOGY SHIFT

- **This results in:**
  - Damaged materials
  - Degraded air quality
  - Human exposures and health risks.



# HEALTH EFFECTS

- *All molds have the potential to cause health effects.* **(US Environmental Protection Agency)**
- *The ACGIH approach has been to emphasize that active fungal growth in indoor environments is inappropriate and may lead to exposures and adverse health effects.* **(American Conference of Governmental Industrial Hygienists)**

# HEALTH EFFECTS

*There is abundant evidence from investigations in several countries that symptoms of eye, nose, and throat irritation as well as cough and tiredness and fatigue are present in excess among persons or populations in certain buildings. Although several agents have been suggested as causative, the most extensive evidence is found for dampness and mold.*

***- American Industrial Hygiene Association***

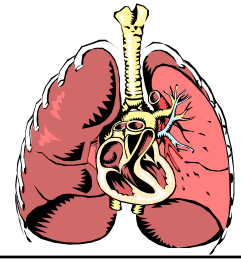
# HEALTH EFFECTS

- The Institute of Medicine of the National Academies of Science, in its June 2004 report on *Damp Indoor Spaces and Health*, found sufficient evidence of an association between damp indoor environments [and their associated microbial contamination] and:
  - **Cough**
  - **Upper respiratory tract (nasal and throat) symptoms**
  - **Wheeze**
  - **Asthma symptoms in sensitized persons**

# HEALTH EFFECTS

- The IOM also found limited or suggestive evidence of an association between damp indoor environments [and associated microbial contamination] and:
  - **Dyspnea**
  - **Asthma development**
  - **Lower respiratory illness in otherwise healthy children.**

# HEALTH EFFECTS



- **Reactive airways disease** (RAD) in children is increasing in many countries.
- The clinical diagnosis of **asthma** or RAD includes a variable airflow obstruction and increased airways responsiveness.
- This condition can develop after an augmented reaction to a specific agent (e.g. mold allergens) and may cause a **life-threatening situation** within a very short exposure period.

# HEALTH EFFECTS

- Apart from respiratory symptoms, some studies demonstrate the presence of general symptoms in terms of **fatigue**, **headache**, and **CNS symptoms**.
- An association between exposure to toxigenic molds and **pulmonary hemorrhage** and death in infants has been investigated and suggested.
- The variety of described health effects from exposure to water-damaged and mold contaminated environments may have consequences for children in the early years of life.

# HEALTH EFFECTS

- A child's immune system develops from birth to adolescence and requires a natural stimulation with antigens as well as inflammatory agents.
- Any disturbances of this normal maturing process may increase the risk for abnormal reactions to inhaled antigens and irritants in the environment.

# HEALTH EFFECTS

- Knowledge of health risks due to mold exposure is not widespread among clinicians, and public health authorities likewise may not be aware of the **serious reactions** mold exposure can provoke in some children.
- Individual physicians may have difficulties treating these children because of lack of recognition of the **relationship between symptoms and the indoor environment**.

# HEALTH EFFECTS

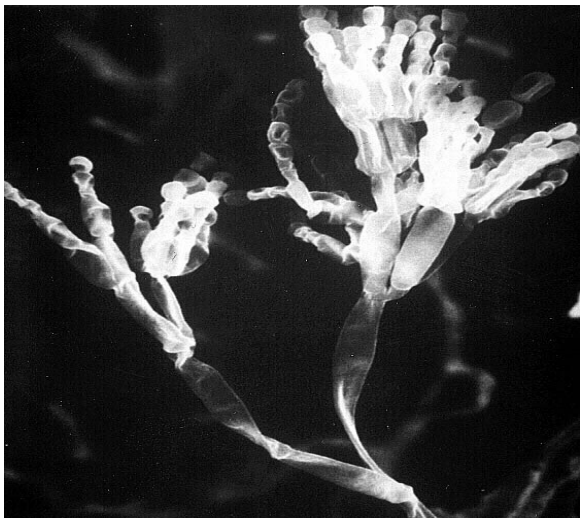
- Thus it is very important that when a physician evaluates a child with these symptoms, specific questions about the home, child care setting, or school environments are asked.
- Children with symptoms related to mold in houses may also be **more susceptible to inhaled antigens** in general, such as particulates, smoke, and chemicals.

# HEALTH EFFECTS

- Child and Family caseworkers must be alert to home conditions wherein a child's illness, in association with excessive water damage and mold contamination, may constitute child neglect.

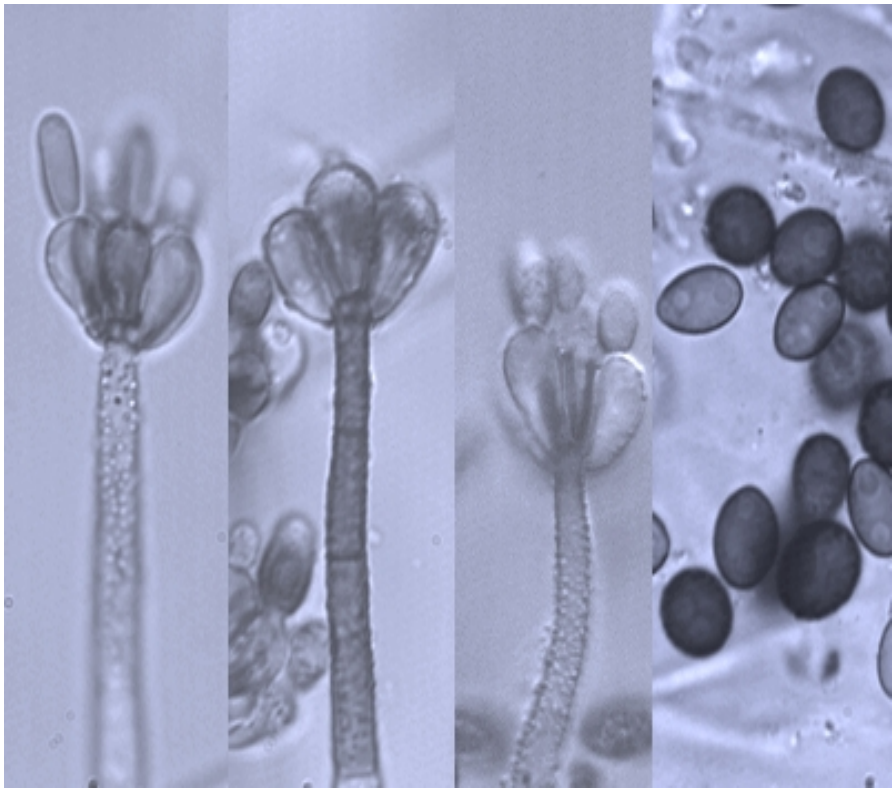
# POTENTIAL ALLERGENS

- *Alternaria alternata*
- *Aspergillus*
- *Aureobasidium pullulans*
- *Cladosporium*
- *Penicillium*



# POTENTIAL TOXIGENS

- *Fusarium*
- *Aspergillus versicolor*
- *Aspergillus flavus/fumigatus*
- *Penicillium*
- *Stachybotrys*



# POTENTIAL OPPORTUNISTS

- *Aspergillus*
- *Fusarium*
- *Alternaria*
- *Rhizopus*
- *Mucor*

# WATER DAMAGE RESTORATION & MOLD REMEDIATION

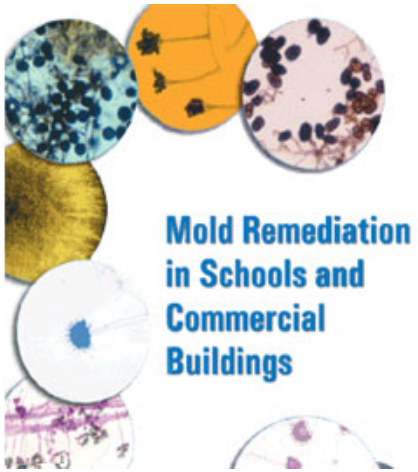
- Professional guidance for water damage restoration provided by the IICRC.
- Institute of Inspection, Cleaning, and Restoration Certification (IICRC) www.iicrc.org
  - ***S500 Standard and Reference Guide for Professional Water Damage Restoration (1999)***
  - ***S520 Mold Remediation Standard – December (2003)***

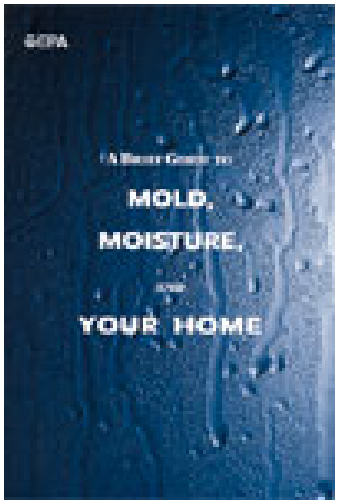
# S520 PRINCIPLES OF MOLD REMEDIATION

- Locate and eliminate moisture sources.
- Physically remove the contamination.
- Clean and dry structural materials.
- Attempts to kill or encapsulate mold are not adequate to solve the problem.

# SCHOOL & HOME RESOURCES

- *Mold Remediation in Schools and Commercial Buildings (USEPA)*
- *A Brief Guide to Mold, Moisture, and Your Home (USEPA)*
- www.epa.gov/



# PREVENTION & CONTROL

- **Remediate Mold**
  - Remove source materials
  - Clean, sanitize/disinfect
- **Control Moisture**
  - Eliminate & prevent sources
- **Reduce Reservoirs**
  - Clean frequently

# CLEANING FOR HEALTH

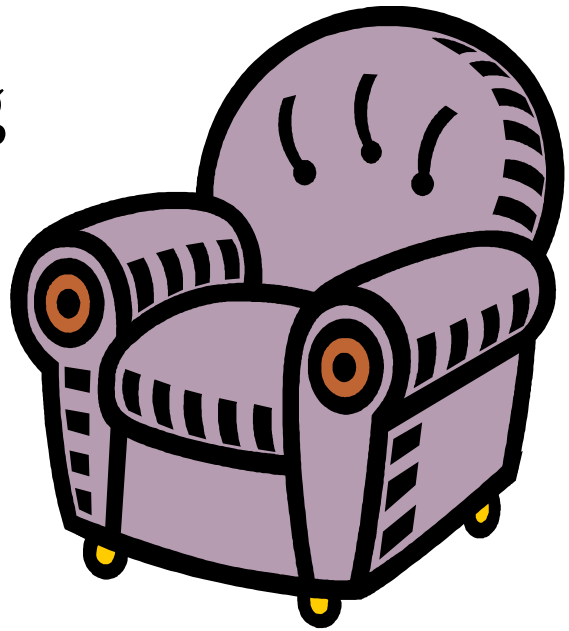
## HEALTHY HARD SURFACES

- Clean daily/weekly
- Disinfect target areas
  - 2-3 times/week
- Control moisture
  - Leaks
  - Condensation
- Reduce dust sources

# CLEANING FOR HEALTH

## HEALTHY UPHOLSTERY

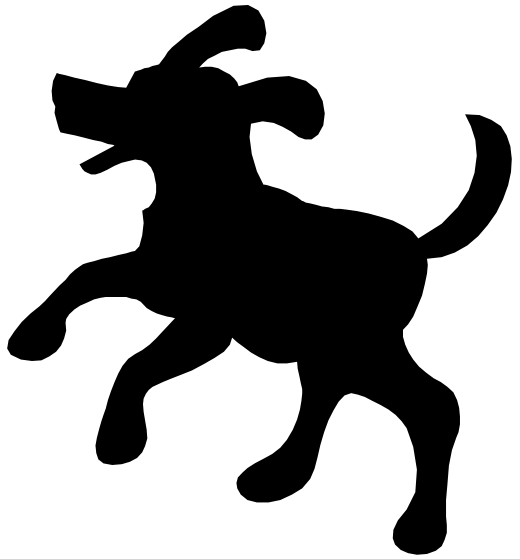
- Clean professionally 2/year
- Maintain (vacuum) 2/month using hi-efficiency vacuum
  - Disposable double-wall bag
  - Exhaust filtration system
- Control moisture/humidity
- Reduce dust sources



# CLEANING FOR HEALTH

## HEALTHY PET AREAS

- Clean daily/weekly
- Sanitize/disinfect
  - Target areas
- Control moisture
- Launder bedding frequently (weekly)



# CLEANING FOR HEALTH

## HEALTHY CARPET

- Clean professionally 2/year
- Maintain (vacuum) weekly
  - Hi-efficiency vacuum
- Control moisture/humidity
- Reduce dust sources

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